Concerning forced circulation, it is easy to conceive that a current of hot gas may pass a finite surface at such a high velocity that its temperature drop or loss of heat may be extremely small. In this case the rate of heat transfer will be very low per unit of surface. On the other hand, it may be conceived that the gas passes the heating surface so slowly that it loses practically all of its heat, and has a large drop in temperature. In both of these cases an inordinate amount of heating surface will be necessary. With the high velocity a very great length of surface will be required. With the low velocity an extremely wide surface will be required. Probably the best analogy to these conditions is supplied by the electrical circuit. A series circuit may have such a high resistance that its power transmission value will approximate zero. A multiple circuit may have such a low resistance

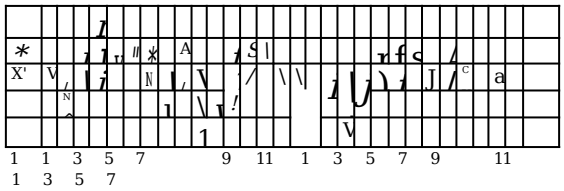

FIG. 154.—Temperature Head or Differential between the Hot Gases in a Fire Box and a Point 1 In. from the Surface of the Wall Exposed to Heat.

that it forms a short circuit and its power transmission value will approximate zero.

The heat differential or temperature head necessary for the heat transfer is a factor concerning which there is considerable disagreement. There is the film theory of high surface resistance due to layers of gas adhering to the surface. Such data as are available indicate that a temperature drop of 300° or more is necessary for gas to gas heat transfer. The curves of Fig. 154 were copied from a pamphlet, " The Plow of Heat Through Furnace Walls“ (Bulletin No. 8, U. S.

Bureau of Mines) by Ray and Kreisinger. The full line shows the fluctuation in the firebox temperature of the experimental furnace as indicated by a thermo couple and the dotted line gives the temperatures of a couple embedded in the brickwork 1 in from the surface exposed to heat. It will be noticed that the brick temperatures lag behind